National Aeronautics and Space Administration
Washington, DC

NASA ADVISORY COUNCIL

February 18-19, 2010

NASA Headquarters
Washington, DC

MEETING MINUTES

P. Diane Rausch
Executive Director

Kenneth M. Ford
Chair

NASA ADVISORY COUNCIL
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Meeting Report

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Announcements and Opening Remarks

Ms. Diane Rausch, NASA Advisory Council (NAC) Executive Director, called the meeting to order and welcomed the NAC members and attendees to Washington, DC, and NASA Headquarters. She reminded everyone that the meeting was open to the public and held in accordance with the Federal Advisory Committee Act (FACA) requirements. All comments and discussions should be considered to be on the record. The meeting minutes will be taken by Mr. David Frankel, and will be posted to the NAC website: www.nasa.gov/offices/nac/, shortly after the meeting. All of the NAC members are serving as experts in their fields and as Special Government Employees. They are subject to ethics regulations, and will recuse themselves from discussions on any topic in which there could be a potential conflict of interest involving themselves or their employers. Any questions should be directed to Ms. Rausch.

Dr. Kenneth Ford, Chair of the NAC, welcomed everyone to the second meeting of the newly restructured NAC. He thanked NASA Headquarters for hosting the meeting and extended special appreciation to the Office of External Relations (OER) and the staff that makes the meeting possible. He explained that the February meeting of the NAC is traditionally held at NASA Headquarters because of the Federal Government budget cycle. The NAC reports directly to the NASA Administrator, presenting findings, observations, and recommendations across the full breadth of NASA's civil space program. Dr. Ford explained that the NAC had recently been streamlined and restructured to permit a more personal interactive style and more effective communications. He was pleased that 10 of the 12 NAC members were present and, at his request, they introduced themselves. Dr. Ford announced that two Council members were not present: Ms. Esther Dyson, Chair of the Technology and Innovation Committee, who had to be in Russia as a member of a delegation from the State Department; and Mr. Richard Kohrs, Chair of the Exploration Committee, who was ill. Mr. Kohrs has replaced Gen. Lester Lyles as the Chair of that Committee because Gen. Lyles has been appointed to a new Presidential panel on intelligence. Gen. Lyles will continue to serve on the Committee.

Dr. Ford expressed the Council's pleasure in having the NASA Administrator, the Hon. Charles F. Bolden, Jr., present and explained that it is the NAC's job to advise and assist the Administrator by serving in a role somewhere in-between being advocates and auditors.

NASA Administrator Remarks

Mr. Bolden expressed his thanks to the NAC members for agreeing to serve on the Council and as the Chairs of their respective Committees. He explained that the rationale for reducing the size of the Council from almost 40 to just the 9 Committee Chairs was to make interaction easier. The 9 Committees are now up and running and all but one has been able to hold an initial meeting. The Committee Chairs are the critical link between the deliberations of the Committees and him. While there are formal times for the Council meetings, he invited their counsel at any time. They should feel free to come in with Dr. Ford and speak with him informally. This year, in particular, their advice will be critical.

Mr. Bolden asked Dr. Ford to maintain the Council's focus on issues of critical importance to NASA. The critically important issues during the coming year are: adapting and adjusting to the budget as well as the implications of the budget, some of which are likely to be unintended consequences; and adjusting the Agency to a new paradigm where we become much more active with what is called "commercial space." There will be much discussion as the year goes by as to what Commercial Space really means. Mr. Bolden

explained that the Council will need to help him find ways to tell the American public, Congress, as well as members of the Administration, what it is that NASA can do and what NASA should be doing in the area of technology development. That is something that NASA has done historically and, over time, has drifted away from. He has been concerned over how the funds for research and development (R&D) at college campuses had dwindled and in many cases had vanished. One thing that excites him about the budget for 2011 is that there is significant money set aside for getting funding back into academia, industry, and the general community. The Center Directors have been informed about his dream to find a way to get funds to them to foster R&D. Originally, he thought it would be a few hundred thousand dollars per Center. Dr. Elizabeth Robinson, NASA's Chief Financial Officer (CFO), will be giving the Council a detailed briefing on the budget. The Council will hear from her that there is significantly more R&D money than he had hoped for, and he is trying to pull some of this forward into this fiscal year. NASA has hired a new Chief Technologist, Dr. Bobby Braun, who has a very detailed plan for restoring and reinvigorating technology R&D for the Agency.

Mr. Bolden stated that he has spent considerable time with Dr. Ford doing the groundwork on the NAC's 2010 Work Plan. The Work Plan should not limit what members do in their Committees, but he wants to ensure that everything in the Work Plan is covered once it is approved. The Work Plan also includes those issues that he has decided (or determined from conversations with the President) are going to be critical.

Mr. Bolden reiterated that he needs the NAC's counsel. He stated that these are exciting times for NASA. It is an emotional time because many people have put their heart and soul into human space flight (HSF), particularly into the Constellation Program (CxP). For them, this is a very difficult time. The science community, however, should feel ecstatic because there is an incredible increase in the budget for science. The technology and aerodynamics communities should also be pleased because the budget has a large amount of money for technology and the Nation's ability to generate a 21st century transportation system. He noted that at a recent Executive Committee meeting for NextGen, the Secretary of Homeland Security, the Hon. Janet Napolitano, reminded him that while she is not a technical person, she is really counting on NextGen. She needs help from the technical community to help generate a new transportation system that can get people from point A to point B as safely and efficiently as possible. Mr. Bolden advised everyone that NextGen is very important and they would hear him say that often. There is more to NASA than HSF. Some of the most dramatic changes and accomplishments that NASA has had have come from other areas. He noted that there are differences of opinion about the value of HSF. As an example, some in science would point to the success of the Hubble Space Telescope (HST). It is an observatory that is the best at what it does; however, it is that way only because it had a visit from humans last year, who did an unprecedented five back-to-back extravehicular activities (EVAs). Mr. Bolden explained that the interaction of humans and robots is critical. He stated that the NAC has the responsibility to counsel him on how NASA can help the American public and the people of the world understand the importance of this issue.

Mr. Bolden discussed NASA's international partnerships. NASA has always been involved in international partnerships, and is stepping up the pace to reach out to non-traditional partners. There are small nations that have no space program but want to be part of the family of space-faring nations and make a contribution. There are also large nations that have money and space agencies, but don't know what to do in the area of space exploration. At the President's request, NASA is also reaching out to predominantly Muslim nations. In the coming year, NASA may be able to enter into agreements with countries like Indonesia. This past year the Agency signed an agreement with Saudi Arabia and Israel for work involving the Lunar Science Institute (LSI). It is very significant when geographic neighbors who can't talk to each other understand the critical importance of cooperating in science and scientific exploration.

Mr. Bolden turned his attention to HSF. He emphasized the importance of a destination and noted that the President had spoken yesterday with astronauts and students at the White House. The President was enthusiastic about HSF and talked about going to Mars and returning to the Moon. The President understands that we must have a destination. For Mr. Bolden, the ultimate destination is Mars. Over the coming years we will try to figure out how to best get there, what the limiting capabilities are, what capabilities we don't have today, and then build a plan. There are intermediate destinations, e.g., the Moon and Near Earth objects (NEOs). Mr. Bolden explained that one of the jobs that he shares with Secretary of

Defense Gates is defense of the planet against things, not people. At a recent Cabinet meeting, Dr. John Holdren, the President's Science Advisor, showed the President an HST image depicting a large asteroid impact on Jupiter that no one had predicted. This got his attention, which generally happens when the talk is about NASA.

In closing, Mr. Bolden stated that NASA is going to be doing some things that the Agency has traditionally not done in the past, and that there may be internal disagreements over how and when they should be done. He again asked the NAC for its counsel. He remarked about a conversation he had the previous evening about information technology (IT) security with Gen. Albert Edmonds, Chair of the NAC Information Technology Infrastructure Committee. One of the issues that Gen. Edmonds will help him with is with IT security. NASA is second only to the Department of Defense in the number of IT attacks, and NASA must find ways to strengthen IT security. Mr. Bolden concluded by reminding the Council that everyone around the table was involved in areas that are critical.

At Dr. Ford's request, the Council members introduced themselves. [Members names and affiliations can be found in Appendix B.]

The President's FY 2011 Budget Request for NASA

Dr. Ford introduced Dr. Elizabeth Robinson, NASA's new CFO, who arrived at NASA Headquarters this past fall. Dr. Ford explained that Dr. Robinson arrived at an historic juncture, noting that last week the President's budget request was unveiled and that NASA received a modest but useful increase over FY 2010 as well as an array of new initiatives and new programs.

Dr. Robinson briefed the NAC members on the President's FY 2011 Budget Request for NASA. She began by quoting from the NASA Administrator's announcement of NASA's budget the beginning of this month. She then reviewed the highlights of the President's FY 2011 Budget Request for NASA. There is an increase of $6.0 billion (B) over five years (FY 2011-15) compared to the FY 2010 budget, for a total of $100 B over five years. There will be significant and sustained investments in 10 areas:

- Transformative technology development and flagship technology demonstrations to pursue new approaches to space exploration;
- Robotic precursor missions to multiple destinations in the solar system;
- R&D on heavy-lift and propulsion technologies;
- U.S. commercial spaceflight capabilities;
- Future launch capabilities, including work on modernizing Kennedy Space Center (KSC) after the retirement of the Shuttle;
- Extension and increased utilization of the International Space Station (ISS);
- Cross-cutting technology development aimed at improving NASA, other government, and commercial space capabilities;
- Accelerating the next wave of climate change research and observations spacecraft;
- NextGen and green aviation; and
- Education, including focus on Science, Technology, Engineering, and Mathematics (STEM).

The Technology Demonstration Program will receive $7.8 B over five years. It will be led by NASA's Exploration Systems Mission Directorate (ESMD) and consist of two main components: (1) a flagship demonstration program; and (2) an enabling technology development program. The flagship demonstration program can include partnerships with international, commercial, and other government entities. It will fund the development and demonstration of critical technologies that reduce the cost and expand the capabilities of future exploration activities and next-generation capabilities. The enabling technology development program, also led by ESMD, will be for less expensive and shorter duration projects that will be competitively selected. Heavy-Lift and Propulsion R&D will receive $3.1 B over five years, funding R&D for new launch systems, propellants, materials, and combustion processes. The program seeks to both reduce costs and shorten development timeframes for future heavy-lift systems.

Robotic precursor missions will receive $3.0 B over five years. This ESMD program will send robotic precursor missions to the Moon, Mars and its moons, Lagrange points, and nearby asteroids to scout targets for future human activities. Missions may include landing on the Moon with a robot that can be teleoperated from Earth with near-live video and demonstrating a factory to process lunar or asteroid materials. The budget for the ISS increases by $463 million (M) over FY 2010, and by $2 B over four years compared to the FY 2010 budget. These funds are intended to support extending the lifetime of the ISS to 2020 or beyond in concert with NASA's international partners.

Dr. Robinson described the budgetary plans for Commercial Crew and Cargo. Building from successful progress in the development of commercial cargo capabilities, the budget invests $6 B over five years to spur the development of American commercial HSF vehicles. NASA will allocate these funds through competitive solicitations that support a range of higher- and lower-programmatic risk systems and system components, such as human-rating (HR) of existing launch vehicles and development of new spacecraft that can ride on multiple launch vehicles. NASA will ensure that all systems meet the Agency's stringent HR requirements . In response to a question, Dr. Robinson explained that the funds for purchasing commercial crew transportation are in this budget element, and that NASA hopes to obligate funds for that purpose before FY 2015. Commercial crew transport is a difficult issue, not only because of HR, but also because of the number of existing systems that may require HR and the number of commercial entities in partnerships or in a collaborative effort.

The budget shows $989 M in FY 2011 and $86 M in FY 2012 for the Space Shuttle to fly out its remaining five flights and to support Shuttle workforce and facility transition efforts. Additional funds are allocated to modernize the KSC to increase operational efficiency and reduce launch costs.

Space Technology will see funds advancements in next-generation technologies to help improve the Nation's leadership in key research areas, enable far-term capabilities, and spawn game-changing innovations to make government and commercial space activities more capable and affordable. NASA has hired Dr. Bobby Braun as its new Chief Technologist, and he will head this effort. It will involve a broad array of participants including academic, commercial, and international partnerships and incorporate the current Innovative Partnerships Program (IPP), including the Small Business Innovative Research (SBIR) and Small Business Technology Transfer Research (STTR) programs. It will focus on key areas, such as communications, sensors, robotics, materials, and propulsion, and it will use prizes and other innovative research funding mechanisms as well as grants and other more traditional funding mechanisms.

Dr. Robinson reviewed the budgets for several other programs. The budget for Earth and Climate Science increases by $382 M over FY 2010, and $1.8 B over four years compared to the FY 2010 budget. Planetary Science will receive funds to identify and catalogue NEOs and has a goal to catalogue 90 percent of NEOs by 2020. Funds are budgeted to restart Plutonium (Pu)-238 production with the Department of Energy (DoE) to support future missions, prepare for the Mars Science Laboratory (MSL) launch, continue concept development for the Europa Jupiter System Mission, and begin flight development of the Advanced Stirling Radioisotope Generator. Astrophysics will receive funds to continue to operate fifteen missions and work towards launching the Nuclear Spectroscopic Telescope ARray (NuSTAR) in 2012 and Astro-H in 2014. The budget provides funds for programs in Heliophysics, including the Solar Orbiter Collaboration with the European Space Agency (ESA). Funds for Aeronautics and Green Aviation are increased by $73 M over FY 2010 and $0.3 B over four years compared to the FY 2010 budget. The budget includes $30 M per year to address operational and safety issues related to the integration of unmanned aircraft systems (UAS) into the national airspace.

The budget continues to fund operations and maintenance of NASA's nine field centers and provides funds to find efficiencies and drive down operation costs. It funds major repairs of NASA's facilities and provides funds to modify or construct new facilities needed to conduct NASA's programs and missions. Dr. Robinson explained that education is very important to NASA and to Mr. Bolden. The budget increases the base NASA education program by $20 M to fund several new initiatives, including the recently announced *Summer of Innovation,* which will establish pilot programs involving NASA scientists and curricula to

inspire middle-school students and their teachers with experiences to spur students to continue in STEM careers.

The final budget item addressed by Dr. Robinson was cancellation of the CxP. The FY 2011 budget cancels this program and provides $2.5 B over two years for related facility and close-out costs, including any increased cost for Shuttle transition due to CxP cancellation. NASA will strive to close out the existing CxP contracts as soon as possible. A tiger team, reporting to the Administrator, will be created to assess workforce, procurement, and other issues. Dr. Robinson noted that NASA is not ending its ambition to explore space. In order to explore new frontiers, NASA is launching a vigorous new technology development and test program that will pursue game-changing technology development to take us further and faster and more affordably into space. NASA's new strategic approach is expected to spawn developments in research and technology that will make future spaceflight more affordable and sustainable, inspire a new generation of Americans, and increase the knowledge of the solar system and universe. The investment will ensure that future space explorers will have tools, capabilities, and knowledge that are only dreamed about today.

Mr. Hanisee expressed concern about all the different elements involved in the CxP cancellation and asked Dr. Robinson about the implications in the budget for employment at NASA's Centers. Dr. Robinson responded that no changes are envisioned for the civilian workforce at the Centers, but added that she could not speak to the contractor workforce. She described how NASA was moving away from full cost accounting to unified labor accounting. All civil service labor will now be covered in one account. One problem with full cost accounting was the difficulty in tracking labor. The pricing of facilities is a difficult issue and would not be affected by the change from full cost accounting.

In response to questions about funding assumptions for commercial resupply, Dr. Robinson explained that the timing of the decision-making and the timing of the budget were not aligned. The concept is to ask the cargo developers to both test existing capabilities and to develop new capabilities. In response to some concerns expressed about an overlap in Committee responsibilities, Dr. Ford requested that three Committees – the Commercial Space Committee, the Exploration Committee, and the Space Operations Committee – coordinate their efforts in this area.

Dr. Ford asked how NASA would know whether 90 percent of NEOs had been identified. The answer (given by the Science Mission Directorate) was that it would be based on how much space had been sampled over a given period of time and statistical analysis. Dr. Kennel, addressing the workforce issue, stated that funding for refurbishment of KSC was an exceptionally good idea. It would account for the employment of about 2,000 people, while the Shuttle retirement would account for about 7,000 jobs lost. In response to his question regarding skill mix overlap, Dr. Robinson noted that there had been a high degree of overlap between Shuttle retirement and CxP initiation. The overlap had been communicated to the workforce, and people had been making plans based on that transition for years. Currently, it is less clear what the overlap is going to be. On the other hand, she noted, NASA has a very resilient workforce that has a lot of skills. In response to a question on Recovery Act funds, Dr. Robinson stated that she is NASA's Recovery Act Officer and that NASA has obligated two-thirds of the funds. The Agency has been doing great on recipient reporting. She noted that if funds are not spent fast enough, they will be reallocated by Congress; however, the Centers have been very responsive and spending is going very well.

NASA Exploration Systems Mission Directorate Update

Mr. Douglas Cooke, Associate Administrator for ESMD, briefed the NAC on the effect of the President's FY 2010 budget request on ESMD. He introduced his new deputy, Dr. Laurie A. Leshin, who is helping him to address the changes that they are responsible for.

Mr. Cooke described the shift in direction due to cancellation of the CxP in the President's FY 2011 budget request. He described the transition from building flight systems to developing capabilities and technologies that will prepare NASA for destinations beyond low earth orbit. There are three new programs in the ESMD budget: Technology Demonstration, Heavy-Lift and Propulsion R&D, and Robotic

Precursors. He noted that the budget also enhances the Human Research Program by 42 percent and that there is now a line item in the budget for Participatory Exploration.

With respect to the facilities that would be used in the Heavy-Lift research program, Mr. Cooke replied that NASA Stennis Space Center (SSC) is the primary Center for testing engines. In response to a question, Mr. Cooke distinguished the approach between the new first stage heavy-lift technology program and the program of record. The LOX (liquid oxygen) and hydrocarbon engine is a very reliable engine, used on Atlas and Saturn in the past and produces high thrust levels for first stage. Shuttle gets high thrust levels from its solid boosters. He explained that these high thrust levels are needed in first stage.

Mr. Cooke discussed the budget for Commercial Cargo and Crew. ESMD has a budget line for efforts to potentially add milestones and content associated with commercial cargo contracts, including additional testing, and potentially providing additional flights that will help achieve earlier mission success. NASA is looking for possible improvements to the Commercial Orbital Transportation Services (COTS) model. He believes NASA has been very successful in working with companies to advance their commercial capabilities to launch cargo. The companies are selected competitively and any company that wants to submit a proposal may do so. NASA will allocate the funds through competitive solicitations that support a range of higher and lower programmatic risk flight systems.

NASA is working toward developing Human Rating Requirements (HRR) for commercial vehicles. NASA will set standards and processes to ensure that all systems meet the Agency's HRRs to maintain the highest level of safety for NASA crews. A team (established a few months ago) is beginning the effort by drawing from the current NASA and Constellation Program requirements. The current COTS efforts have addressed aspects of HRR, because the contractors must respond to the ISS Visiting Vehicle Requirements. These requirements are used for interfacing with and flying near the ISS in order to protect the crew on ISS. The HRR will be more involved as the designs are developed for launching and transporting crews to and from low Earth Orbit. Mr. Cooke stated that HRR is more than just requirements; it also includes the entire process for developing systems. NASA looks at safety throughout the development process. The plan is to finish the preliminary work as soon as possible in order to get started on proposal solicitation early in 2011.

Col. Collins noted that the Space Operations Committee had looked at the HSF standards document, which contained detailed information. This information had been provided to the commercial companies. However, there are many embedded requirements in other requirements documents for crewed vehicles. Currently, there is an effort to pull together the long list of documents and requirements in one place. ESMD also wants to ensure that the requirements are not over-specific and prescriptive. In terms of the timeline, Mr. Cooke stated that there is an initial draft. NASA intends to request comments from industry on the final draft in a few months and complete the activity by the end of this fiscal year.

In response to a question regarding the work from Orion that can be salvaged, Mr. Cooke noted that this assessment is underway. Some embedded work can be carried forward.

The $6 B for Commercial Crew Development is a mix of industry and NASA internal cost, but the vast majority of the money should go to industry. Mr. Hanisee opined that the $6 B under the Space Act Agreement should be used to encourage industry to spend its own money. One of the most important things for the future will be the HRR handbook, and it could frustrate efforts if not done properly. Mr. Cooke suggested that it would be worthwhile to have it reviewed by the NAC, and some of the members concurred and emphasized how important the handbook would be over the next decade. Mr. Cooke indicated that ESMD would have primary responsibility for the document. Dr. Ford stated that the NAC would be happy to look at the emerging document and suggested it would be a good topic for the Exploration, Space Operations, and Commercial Space Committees to review together. Mr. Cooke noted that another external group that would be looking at the document is the Aerospace Safety Advisory Panel (ASAP). Col. Collins stated that her Committee would want to look at the crew escape system

Mr. Cooke discussed the CxP, which is cancelled in the FY 2011 President's Budget. Until the budget is approved by Congress, NASA will continue to execute the Program, and the Preliminary Design Review (PDR) is scheduled for early March. Working with Congress, NASA will strive to close out the existing

CxP contracts as soon as possible. Nine study teams have been assembled to assist in the change in direction. Five will be involved in pre-formulating new programs, one will assess transition of CxP, and three will be Agency cross-cutting teams. The teams will focus on planning at the program level without getting involved in specific projects or missions. The teams will not be involved with program execution, assigning work, defining Center participation and management of programs, or developing or awarding new contracts. These decisions will be made through the ESMD and the Agency decision processes. The largest team is the Constellation Transition Team, which is responsible for developing options and recommendations for rapid and cost effective ramp-down of the program. This includes assessing the impact to existing contracts, government workforce, support contractor workforce, and institutional services and facilities. The team lead is Dr. John Olson. The Flagship Technology Demonstrations Team, will formulate plans for a series of in-space demonstrations that validate next generation capabilities that are key to sustainably exploring deep space. Other teams are the Enabling Technology Development and Demonstration Team, the Heavy Lift and Propulsion Technology Team, and the Exploration Robotic Precursors Team. The Commercial Crew Team, headed by Mr. Geoff Yoder, will formulate plans to expedite solicitation and selection of new COTS partners. It will develop a plan that supports the development of commercial crew transportation providers to whom NASA could competitively award a crew transportation services contract. The three cross-cutting study teams are: the Integration Team, which will integrate all the data collected across the study teams; an International Team, which will infuse and incorporate international opportunities into the new program; and the Participatory Exploration Team, which will work to increase public participation and coordinate NASA-wide efforts to incorporate participatory exploration into future missions.

Dr. Kennel requested additional information about the International Team and what they will be examining. Mr. Cooke explained that the Team is led by Ms. Kathy Laurini, who had been the ISS representative to ESA. She understands the ways in which other countries want to engage with NASA, such as through participation in precursor missions. Some countries may have their own precursor missions in which NASA might want to participate. International Traffic in Arms Regulations (ITAR) issues must be addressed as part of this effort. The International Team will also focus on the non-traditional partners. The target audience for the Participatory Exploration Team will be the public and schoolchildren.

Mr. Cooke concluded his presentation by stating that there has not been a grand departure from NASA's interest in technologies. The technologies that are being addressed in the new budget include technologies that have been known about but not invested in significantly in the past. In addition, there is funding for more basic research that will lead to new ideas for the next wave of technologies in which NASA will be investing. Mr. Cooke stated that he looks forward to working closely with the Commercial Space Committee and the Space Operations Committee. Dr. Ford indicated that a strong effort will be made for those Committees to meet on the same days immediately prior to the April NAC meeting at Johnson Space Center (JSC). He added that the new technologies look very exciting.

With respect to the new approach to human exploration and the process to construct a new roadmap, Mr. Cooke noted that ESMD is using a two-phase approach, and there is a wealth of knowledge to build on. In the near term, ESMD will want to kick off a team effort, reviewed by all the Mission Directorates and the Chief Technologist Office, to map out Design Reference Missions to the various possible destinations. He observed that NASA has not spent much time on human mission concepts for NEOs and is learning more about them. Knowledge about NEOS has increased and there is going to be heightened interest; however, a broader buy-in is needed from constituents. Some objectives will be more science driven. The Moon obviously has a component of science, although human missions may not be completely science driven. However, once you move beyond the Moon, exploration tends to be more science driven. Col. Collins asserted that it is very important for organizations to define where they will be in 5, 10, and 15 years, and that not knowing where we are going is not the message that NASA wants to send.

Dr. Ford addressed the matter of precursors and the importance of destination. NASA needs to formulate the story for the American people or the Agency will be vulnerable. Mr. Cooke agreed and stated that NASA needs to define what it needs to learn from these missions. With respect to the timeline for the nine teams, Mr. Cooke noted that the teams would phase out after they develop a focused effort; however, the transition will be ongoing for a considerable time, so the transition team may need to be longer term. In

response to a question, Mr. Cooke explained that the $5 M for Participatory Exploration is for a coordinating group that will be used to coordinate efforts across the Directorates.

Aeronautics Committee Report

Ms. Blakey presented a slide on the Aeronautics Research Mission Directorate (ARMD) R&D Strategy. It proposes using a "Seedling" fund to foster revolutionary ideas that would encourage a more robust technological transfer to industry through innovative fundamental research. This would lead to system level research to realize the next set of technological breakthroughs, which in turn would lead to further fundamental research. Ms. Blakey described NASA's Aeronautics Programs. The Fundamental Aeronautics Program conducts cutting-edge research to produce innovative concepts, tools and technologies. The Integrated Systems Research Program conducts research at an integrated system level. The Airspace Systems Program addresses the fundamental ATM (Air Traffic Management) needs for NextGen. The Aviation Safety Program conducts cutting-edge research to improve the intrinsic safety attributes of current and future aircraft. The Aeronautics Test Program preserves and promotes the testing capabilities of flight and ground-based research facilities.

Ms. Blakey reviewed a slide describing ARMD's future directions. The Directorate intends to ensure a clear distinction in purpose and proper balance in resources between fundamental research and the Integrated Systems Research Program and strong relevance and technology transfer within all fundamental research programs. ARMD will address the most compelling national challenges through integrated systems research. The Directorate will strengthen assessment and validation in relevant environments and will coordinate with new space technology for promoting innovation and leveraging hypersonic research. Ms. Blakey described the Committee's FY 2010 Work Plan. The Committee will review or advise on the following: goals and progress for mitigating the environmental impact of aviation; effective ways to address NextGen challenges; fostering growth in the aeronautics workforce; technology transfer from fundamental research programs to the Integrated Systems Research Program; the new FY 2011 program initiatives, particularly Unmanned Aircraft Systems (UAS) and Verification & Validation (V&V); and new research areas that would provide high-value for NASA Aeronautics. Additional areas of interest are: domestic and international collaborations; promoting understanding of ARMD's programs, goals and impacts with the public; and the approach and progress for strategic collaboration with DoD on national testing capabilities and facilities. Ms. Blakey reported that the Committee felt that the R&D Team has a strong visionary sense and is working closely with industry and the government.

Ms. Blakey reported that the Committee has four initial observations at this time. The Committee endorses the Environmentally Responsible Aviation Project and believes operational and avionics research could strengthen the project. The Committee is encouraged to see the new Agency focus on space technology and is interested in collaborating with the NAC Technology and Innovation Committee to ensure a coordinated Agency research strategy. The Committee feels that NASA needs to consider the proper strategy for engaging non-traditional partnerships. The Committee wishes to maintain awareness of how NASA is measuring progress in its fundamental research programs. Ms. Blakey described the Committee's future plans. There will be a WebEx meeting for detailed programmatic briefings. There will also be a meeting at Langley Research Center (LaRC) on April 22-23, 2010, where the Committee will be briefed on UAS planning, V&V planning, and the Aeronautics Test Program Strategic Plan

In response to a question, Ms. Blakey stated that the Committee had not addressed the question of whether NASA has a strategy for aeronautics that successfully bridges large and small businesses, prime contractors and subcontractors. She noted that small businesses account for 70 percent of all work because of the huge supply chain. Mr. Miles O'Brien observed that there are tremendous stories to tell and asked whether the Aeronautics Committee had discussed the stories and how to disseminate them. Ms. Blakey noted that there was huge energy in this area and that there are terrific stories on the difference that is being made and the successes that are being achieved. Mr. O'Brien recommended that the Committee promote that as much as possible.

Audit, Finance & Analysis Committee

Mr. Robert Hanisee, Chair of the Audit, Finance and Analysis Committee, gave a presentation on the NASA Fiscal Year 2009 Audit Report. The result of the Report, for the seventh consecutive year, was a disclaimer by Ernst and Young, LLP, NASA's external auditors. Mr. Hanisee characterized this as a "non-opinion" opinion. The disclaimer was issued due to the auditors finding three problems—a material weakness and two significant deficiencies. The material weakness was control over legacy property, plant and equipment (PP&E). The two significant deficiencies were: (1) estimating NASA's environmental liabilities, and (2) having financial management systems not in compliance with Federal Financial Management Improvement Act (FFMIA) standards.

Mr. Hanisee described the history of NASA's financial control problems. He noted that in 1960, the General Accounting Office (GAO) placed NASA on its High Risk List, one of 14 agencies. He explained the issues that led to the auditor's disclaimer. He observed that in 2005, at a Congressional subcommittee hearing, the NASA Inspector General (IG) noted that the Agency's problems were rooted in historic culture. A significant part of the problem was unreliable historical data. The accounting personnel at NASA Headquarters were insufficiently trained on the new core accounting system. At NASA's Centers, there were weaknesses and insufficient controls to detect mistakes early in the accounting cycle. There were several additional problems including: control and accounting for NASA owned property, travel expenses, and grants; personnel shortfalls; unobligated balances; and the insufficient number of transactions to justify the NASA Shared Services Center (NSSC) at SSC.

Mr. Hanisee reported that there has been improvement. In the FY 2008 Audit, the auditor stated that "significant progress has been made." In public testimony, the NASA IG stated that "NASA has made significant progress in remediating financial management weaknesses." Mr. Hanisee reviewed a table showing that NASA has made significant progress in remediating the majority of its material weaknesses in internal controls. He described what has been done or still needs to be done to resolve the outstanding financial issues and most importantly, accounting for legacy property, plant and equipment. NASA should be fully compliant in FY 2010.

A major dilemma was NASA's inability to properly account for legacy PP&E. The auditor would not give a full audit opinion until this matter was resolved. The IG, on the other hand, would not authorize NASA to spend the money it would take to recreate the records needed to satisfy the auditor. The problem was solved when the NASA's CFO successfully petitioned the Federal Accounting Standards Advisory Board (FASAB) for a clarification of accounting standards. FASAB recognized that the nature of NASA's problem, primarily the cost valuation of the International Space Station prior to 2002, was PP&E that predated current accounting standards. In October 2009, the FASAB issued a new accounting standard with a clear intent to provide flexibility in estimating practices. FY 2010 provides a window of opportunity for NASA to resolve the PP&E weakness and achieve a clean audit opinion. The Audit, Finance and Analysis Committee has been closely tracking this issue for years and believes the estimating methodology NASA has developed is sound and, if properly implemented, would meet the intent of the new standard. The Committee has made two suggestions to NASA's CFO to help ensure an understanding and acceptance of its methodology in order to comply with the new standard: (1) NASA should develop a formal methodology paper that lays out the estimating criteria and the approach being taken by NASA to ensure the estimate is reasonable for the PP&E purchased both pre-and post-2002; and (2) NASA should develop the footnotes and disclosures to the financial statements necessary to tell NASA's story and permit a reader to understand the nature of NASA's assets and estimation methodology.

The Committee will monitor efforts by the NASA CFO to work with the auditors to gain acceptance of the estimation methodology. The Committee will also provide advice to NASA's CFO with respect to the estimation methodology, the articulation of the methodology paper, and the financial statement footnotes and disclosures necessary to support a reasonable estimate that meets the intent and leverages the flexibility provided by the FASAB and that will pass the audit test.

Mr. Hanisee described the challenges in accounting for NASA's Unfunded Environmental Liabilities (UEL). The Committee will review the Agency's methodology to estimate the UEL for existing programs

and assets as well as future assets, and it will review the Agency's accounting treatment for both existing and future UELs. Future activities planned for the Committee include: reviewing the effect of future NASA budgets on financial stewardship; meeting with key stakeholders, specifically the Deputy Administrator, the IG, and Ernst & Young's engagement audit partner; reviewing the financial reporting of Recovery Act funding; and reviewing the accounting treatment for changes to or cancellation of the CxP.

In response to questions regarding the relationship between the CFO Office and the Center financial offices, Mr. Hanisee explained that the CFOs at the Centers formerly reported to the Center Director. Now, they report to the Headquarters CFO. The Agency will not be removed from the GAO's High Risk List until there is an unqualified audit opinion; however, the Committee believes that NASA can obtain a good audit opinion this year.

Commercial Space Committee Report

Mr. Bretton Alexander, Chair of the Commercial Space Committee, briefed the NAC on the Committee's status and its tentative Work Plan. The Committee Work Plan includes: advising on how best to optimize NASA's organizational elements and address cultural issues to effectively encourage and promote the development of a commercial space industry; reviewing NASA's strategy and plans for stimulating a commercial space industry; providing advice on effective and appropriate methods for NASA to stimulate, encourage and partner with commercial space; identifying the logical progression for developing a commercial capability for transportation to the ISS and Low-Earth Orbit (LEO); and reviewing and advising on NASA's strategy for partnering and cooperating with other Federal agencies on commercial space. The Committee will also provide advice on how NASA should define "commercial space." The next meetings will be March 30, 2010, in Washington, DC, and April 26, 2010, in Houston, Texas.

Mr. Alexander reported on several briefings given to the Committee by NASA. A briefing was given on NASA's Commercial Space Efforts by Mr. Doug Comstock, Director of NASA's Innovative Partnerships Program. Mr. Comstock discussed the meaning of commercial space, seed fund partnerships, licensing, service purchases, Facilitated Access to the Space Environment for Technology Development and Training (FAST), the Commercial Reusable Suborbital Research (CRuSR) Program, Centennial Challenges, the Commercial Reusable Launch Vehicle Technology Roadmap study, and the Commercial and Government Responsive Access to Space Technology Exchange (CRASTE).

The Committee was briefed by Mr. Charles Miller from the IPP on CRuSR and a potential NASA strategy for achieving low-cost and reliable access to space. This briefing covered historical attempts at achieving low-cost reliable access to space, historical lessons on development of the airplane and NASA's predecessor, the National Advisory Committee for Aeronautics (NACA), the CRASTE program, and the CRuSR program. A briefing was given on Commercial Cargo and Crew by Mr. Geoff Yoder from ESMD. This briefing covered the Commercial Orbital Transportation Services (COTS) Program, the Commercial Crew Development (CCDev) Program, an integrated approach for Commercial Crew services, and HRR for Commercial Crew. During this briefing, the Committee learned that the commercial crew requirement would be six seats per year, which may not be enough to sustain a commercial market. A briefing was given by Mr. Sam Scimemi, Space Operations Mission Directorate (SOMD), on the status of the ISS. Mr. Scimemi covered the ISS cargo and crew requirements, the current transportation arrangements, COTS and Commercial Resupply Services (CRS) flights, and the ISS's commercial potential.

Mr. Alexander reported that the Committee has discussed the priority on commercial crew and cargo programs, given the recent CxP cancellation by the President's FY 2011 budget. Mr. Alexander reviewed a chart analyzing the attributes of commercial versus traditional government contracting. The Committee reviewed lessons-learned from previous commercial space efforts, including SpaceHab and the Evolved Expendable Launch Vehicle (EELV).

It was noted that the Russians are a competitor for launches to the ISS, and NASA is under contract with Russia through 2013 for launch and 2014 for landing. It will be interesting to see how the Russians will price the launches and the effect that pricing will have on commercial launches. With respect to the

potential size of the market and how many providers the market could sustain, Mr. Alexander noted that the best example is the EELV. From NASA's perspective, there is a qualitative analysis to be made in determining who should receive Space Act Agreements. In response to comments, Mr. Alexander stated that there is no way the commercial crew launch business can get started without Government help. In 10 to to 20 years, it might develop on its own; however, it would probably not have the capabilities that NASA would want. Potential customers might be sovereign nations without their own capability and perhaps habitat-type markets. Mr. Alexander agreed that venture capital is not beating the doors down. He added that only the companies funded by NASA in the COTS program could access private capital, and even that is not a guarantee to obtaining venture capital.

Education and Public Outreach Committee Report

Mr. O'Brien introduced the members of his Committee and their qualifications. He also noted that they would like to add a person with solid K-12 educational credentials to their membership.

Mr. O'Brien reported on the presentation on Education and Public Outreach (EPO) given by Mr. Morrie Goodman, NASA Assistant Administrator for Public Affairs, and Mr. Bob Jacobs, his deputy. A recent poll showed that 86 percent of those polled are satisfied with the NASA web page. Although nothing needs to be done to improve the web page, improvements are desired moving further toward Web 2.0 and social networking. Mr O'Brien noted that there is concern, however, that with more extensive use of social media — some information might not emerge as Public Affairs would prefer. Accordingly, there is a need to figure out what are the "third rails" as well as the rules of decorum for a Federal agency when using social media. Dr. Ford noted that NASA TV is in 30 million homes, and that someone from the EPO Committee had mentioned to him that for better or worse ... it is currently a kind of "reality TV" ... but with great untapped potential. Mr. O'Brien agreed that there are private entities that would like to do business with NASA. In response to a question, Mr. O'Brien stated that turning NASA TV over to a private entity had been considered, but there are a lot of issues, particularly in areas like commercialization and private marketing.

Mr. O'Brien next reported that during their recent meeting, a presentation had been given to the EPO Committee by Dr. Joyce Winterton, NASA Assistant Administrator for Education and her deputy, Mr. James Stofan, Deputy Assistant Administrator for Integration. In the EPO Committee meeting, Dr. Winterton had made the observation that that she had never seen the stars align better for STEM, and that if NASA couldn't do something now — it never would; however, NASA needs help with metrics. She also said that she would like to enhance NASA's relationship with museums.

Mr. O'Brien offered his Committee's first initial impressions: He asserted that NASA needs a succinct message and offered several possibilities:

- NASA: Where the Future is Imagined
- We Own the "Awes"
- Protecting the Planet – Pushing the Boundaries
- NASA: Exploring New Horizons for All Mankind
- Seize the Shuttle Swan Song Moment

He predicted that with the Space Shuttle era ending, the media will be beating a path to NASA and he suggested that NASA should capitalize on the crescendo of interest. He advised NASA to embrace the nostalgia and use it to embed the forward message. He said the Agency has an important opportunity to capture some eyeballs. Mr. O'Brien noted that there is substantial uncertainty over the issue of what kind of marketing that NASA may engage in and asked "Where do you draw the line?" There is a need to obtain an accurate opinion on the scope for appropriate marketing activities, e.g., what limits are real, how much is myth, and how much is subjective. He believes that marketing dovetails with a push to commercial crew and cargo. He posed the question: What is the value of the meatball?

Dr. Ford explained that the military has an advertising waiver and exemption for recruiting. Mr. O'Brien stated that there is a need to know exactly where are the edges for marketing with respect to NASA. Dr. Ford suggested that it would be worthwhile to learn more about the issue and its history, and it would be a good subject for Committee discussion. He suggested that the Committee investigate the policy issues surrounding NASA marketing and review the history of the issue. Mr. O'Brien asserted that an agency that is now engaging the private sector should be able to act more like the private sector. The concern is that there will be subversion of the political message. Culturally, the Agency needs to understand and get beyond the longstanding concern that "marketing" NASA is not allowed. It was noted that NASA will soon need to rewrite the international agreement for the ISS. The most remarkable success of ISS is the untold story of cooperation at the international level. Another good reason to extend the ISS is to avoid destroying the team that is the prototype for the partnership that will take us to Mars.

Mr. O'Brien reported that the most recognized engineering figure on TV today (according to Michael Bostic) is Homer Simpson. There could be a "Project Hollywood." The Pentagon is proactive and NASA should be also. What NASA symbol can create lasting impressions?

Update on Non-Traditional International Partnerships

Mr. Michael O'Brien, NASA Assistant Administrator for the Office of External Relations, gave a presentation on the status of NASA's Non-Traditional International Partnerships. The White House has announced a new charge for NASA that is a change in emphasis, rather than an entirely new direction. Mr. O'Brien provided an overview of international cooperation at NASA. It is directed by the National Aeronautics and Space Act that created NASA in 1958. There have been over 3,000 Space Act Agreements. Currently, there are 458 active international agreements, of which two-thirds are in NASA's science missions. Eight partners account for half of the agreements: France, Germany, ESA, Japan, the United Kingdom (UK), Italy, Canada, and Russia. The remaining agreements are spread among 108 other countries, many of which are "Non-Traditional Partners," primarily located in Central and South America, Africa and the Middle East, Asia, and the Southern Pacific. Mr. O'Brien explained the guidelines for international cooperation. NASA's international partners are generally government agencies. Each partner funds its respective contributions, but contributions need not be equivalent. There is no exchange of funds. Cooperation must be consistent with U.S. foreign policy objectives. Partnership projects must have scientific and technical merit and must demonstrate a specific benefit to NASA. They are structured to protect against unwarranted technology transfers and are documented in a written agreement, closely coordinated with the Department of State and other U.S. Government agencies, including the U.S. Agency for International Development (USAID), the White House Office of Science and Technology Policy (OSTP), and the National Security Council (NSC.)

Mr. O'Brien described NASA's approach to Non-Traditional Partnerships. He stated that NASA's efforts are consistent with the Administration's interest to foster new science and technology (S&T) cooperation globally and emphasize STEM education initiatives. NASA's initial focus is on opportunities that are mutually beneficial, easy to implement at low cost, and have a high impact in terms of results and societal benefits. He explained that the Administration is seeking to enhance S&T with Muslim majority nations, and he described NASA's ongoing and planned activities to support this initiative.

Mr. O'Brien described three examples of existing international cooperation: Global Learning and Observations to Benefit the Environment (GLOBE), the Aerosol Robotic Network (AERONET), and a state-of-the-art Earth observation system called SERVIR, meaning "To Serve." Other potential areas of cooperation include the Space Geodetic Network, ISS research, the NASA LSI, Astrobiology and Terrestrial Analog sites, Calibration and Validation Campaigns, and Ground, Balloon and Sounding Rocket-based "in-situ" data. Mr. O'Brien described some of the challenges faced by NASA in this field.

NASA will continue consulting with other U.S. Government agencies and is getting positive feedback from senior people in the Administration. NASA will continue to participate in regional conferences, workshops and meetings, and will participate in meetings that it has not attended in the past. The Agency is drafting "statements of intent" for cooperation with Indonesia, Malaysia and Vietnam. There will be a periodic

assessment of progress. Mr. O'Brien concluded his presentation by stating that international cooperation contributes significantly to NASA's mission and to national goals, as well as to the national objectives of partner countries.

In response to a question from Mr. Brett Alexander with respect to China, Mr. O'Brien noted that in 2006, Administrator Griffin attended a summit there. A recent summit by the new President brought a new joint agreement, and further guidance from the Administration is expected. In response to a question, Mr. O'Brien stated that there is a good relationship with India, and there have been discussions about future missions, including HSF activities. It was noted that an indirect outcome from the recent environmental summit in Copenhagen will be the need for access to the advanced analytical tools that NASA can provide.

February 19, 2010

Information Technology Infrastructure Committee Report

Lt. Gen. Albert Edmonds, Chair of the new Information Technology Infrastructure Committee, reported on the status of his Committee. The Committee supports and advises the NASA Administrator, the Office of the Chief Information Officer (CIO), and other NASA Mission Directorates. The Committee scope includes all NASA IT infrastructure-related programs, projects, activities, and facilities—including high performance computing.

The Committee's first meeting was held on February 11, 2010. The members were interested in leveraging capabilities and bringing in new technologies. They discussed their objectives, which were to identify the primary and secondary focus interests, review committee responsibilities and processes, review NASA's IT infrastructure, develop a Work Plan for the first year, and set up logistics for future meetings.

Gen. Edmonds explained what is meant by a "Contested Cyber Environment." It is a circumstance in which one or more adversaries attempt to change the outcome of a mission by denying, degrading, or destroying cyber capabilities, or by altering the usage, product, or confidence in those capabilities. He noted that NASA operates in five domains: ground, maritime, air, space and cyber. "Information Assurance" means measures to protect and defend information and information systems; "Mission Assurance" means measures required to accomplish essential objectives of missions in a contested environment. He emphasized that Information Assurance is necessary but not sufficient for Mission Assurance.

Gen. Edmonds reviewed a chart showing the elements of the contested cyber environment: exploits, targets, and effects. The various exploits are insider attack and unwitting behavior, data and policy corruption, code manipulation and malware, worms and viruses, life-cycle implants of backdoors, and physical destruction and eavesdropping. There are three exploit levels: network wars, cyber adjunct to kinetic attack, and malicious manipulation. Infrastructure security should not be separate from cyber security. Gen. Edmonds described NASA's IT challenges. Software challenges arise from a lack of consistent enterprise solutions and managing the maturing application portfolio. There are IT security challenges where software assurance does not include comprehensive IT security, and IT security risks to the mission are not fully understood. There are major user challenges caused by an inconsistent user experience across NASA, the need to balance usability with information risk security mitigation, and delays in getting new tools and technologies to users. There is a need to make security seamless to NASA's program managers.

Gen. Edmonds discussed the Committee's potential Work Plan. Subjects include efforts to immediately marry the IT infrastructure and cyber security; making NASA IT the greenest in the U.S. Government; benchmarking NASA's cyber security practices; developing a seamless infrastructure for NASA's ground and spaceflight network; and managing NASA's IT infrastructure. There is a need to identify how data can be transferred from one program to another to save resources. He stated that he could not find NASA's IT structure and observed that programs often just have software needed for that program, without integration into the rest of the Agency. As an example of the problem, he described what occurred when B-2 bombers were delivered with software that was not integrated with the rest of the Air Force.

Gen. Edmonds concluded by committing to have the Committee find out as much information as it can about what NASA's people are doing. He added that he has always been impressed with the talent at NASA, even when he was with the Air Force. It is the leading edge of our scientific community.

In response to a query, Gen. Edmonds indicated that there are no "silver bullets" and that all systems have potential vulnerabilities, which is why security in depth is so important. There will always be software upgrades and patches because it is a constant battle. Security systems, policies, and procedures must continuously evolve as new threats are identified. In addition, NASA should strive to make its IT the greenest in the U.S. Government and should make recycling computers a priority. Dr. Ford pointed out that "energy aware" and "energy efficient" computing will be important in the future.

Science Committee Report

Dr. Wesley Huntress, Chair of the Science Committee, introduced his Committee members and gave a status report to the Council.

Dr. Huntress stated that he would describe NASA's science results by starting with the inner solar system and working his way out. The MErcury Surface, Space Environment, Geochemistry, and Ranging (MESSENGER) mission just released the first global map of Mercury. The Terra satellite has been taking striking images. The Gravity Recovery And Climate Experiment (GRACE) mission uses two spacecraft to measure mass. He described the status of the Mars rover, *Spirit,* the efforts made to free it, and problems associated with the upcoming Martian winter. The Cassini fly-by mission has been focusing on "jets" seen emanating 50 kilometers high from Enceladus' surface, one of Saturn's moons. Cassini now supports the long-held hypothesis that Titan, Saturn's largest moon, has a hydrologic cycle like Earth but based on methane.

Dr. Huntress described the FIRST Robotics Program. It is a national competition where high school students team with engineers from government, industry, and universities to get an exposure to the engineering and technical professions. NASA is now the largest participant in the program, sponsoring nearly 300 of the 1800 teams competing in 2010. The fact that ten percent of Massachusetts Institute of Technology's incoming freshman class are alumni of the program is a measure of success.

Astrophysics had a banner year. The last infrared survey was in the 1980's, and technology today has improved greatly with the Wide-field Infrared Survey Explorer (WISE) project. HST had its fifth servicing mission and is operating as a new telescope. The Stratospheric Observatory For Infrared Astronomy (SOFIA) is now undergoing flight testing. NASA has been working with the Europeans on the recently launched Herschel & Planck space telescopes. Dr. Huntress described the recent White House Star Party, where telescopes were brought to the White House to show children the stars in the sky. The President wants to repeat this event. Kepler, launched this year, is staring at one part of the sky with thousands of stars, looking for Earth-like planets. So far, it has discovered five exoplanets. The confidence level in the Mars Science Laboratory (MSL) project is increasing and it appears to be in good shape. The James Webb Space Telescope is also in good shape, and the mirrors are being delivered. The recently launched Solar Dynamics Observatory (SDO) has a goal to understand the solar variations that influence life on Earth and humanity's technological systems.

Dr. Huntress discussed the FY 2011 Budget Request. He first referred to a recommendation that was made at the April 2009 NAC meeting to encourage NASA to work with OTSP and other agencies at the highest levels to define responsibilities for NASA and to secure funding for Earth observations beyond those recommended by the Earth System Science NRC Decadal Survey. That has happened. The FY 2010 budget has allowed NASA to complete the development of foundational missions and about half of the missions recommended in the Decadal Survey. The FY 2011 President's Budget will allow NASA to do almost all of the decadal missions as well as National need missions in climate monitoring, and low-cost venture missions that were not included in the Decadal Survey recommendations.

In response to a question, Dr. Huntress explained that there are four disciplines in NASA's Science Mission Directorate (SMD): heliophysics, astrophysics, planetary science, and Earth science. There are around 20 missions in flight for each. Missions defined by the Earth Science Decadal Survey are science missions to learn about the processes that make Earth work. The National needs are for long-term monitoring measurements that affect climate.

Dr. Huntress described the Solar Probe Plus mission. It is NASA's first mission to a star – our own. The spacecraft will fly through the solar corona and represents an incredibly difficult technological challenge. He described NASA's NEO Search Program, and the Congressional mandate for NASA to find 90 percent of all NEOs that are greater than 140 meters in diameter by 2020. He reported that the budget and access to resources is insufficient to accomplish this mandate. NASA is using ground-based telescopes that are not NASA owned and user-time is limited. The recently launched WISE has a wide-angle camera and should help with this effort. The additional $16 M in the FY 2011 budget will also help. In response to a question, Dr. Huntress discussed the Arecibo Observatory and noted his concern over a National Science Board recommendation to close it in the absence of new funding or customers. He confirmed that there had been a $2 M shortfall, and the Observatory was to be closed unless it received more funds. The additional money in the budget will help keep it going.

Dr. Huntress stated that the Committee had one Finding and three Recommendations. He asked Dr. Kennel to read and discuss the Finding:

> **Long-Term Data Series in Earth System Science**
> **The Administration's 2011 budget explicitly allows NASA to undertake missions that enable the continuation of long-term data series in Earth system science. This profound decision recognizes NASA's technical leadership and permits NASA to play a stronger role in the provision of measurements that the Nation needs. It recognizes the fact that understanding many complex issues in Earth system science requires long-term data. The assurance of long-term access to high quality data will encourage a broad range of users to develop new research and applications products.**

Dr. Kennel explained that the 2011 budget settles issues that have been contentious and unsettled for a decade over who has the responsibility for making the long-term measurements that support climate science – NASA or NOAA. NOAA's budget has been increased significantly, and this will allow NOAA to carry out new functions. The Administration made the decision to go back to the successful way that weather satellites had been previously obtained: NASA builds the satellites in collaboration with NOAA, the funding comes through the NOAA budget, and NOAA uses them to make weather predictions. The next generation weather system will be built under the same procedure. The Administration also provided NOAA sufficient funding for a nation-wide climate services program. The long-term data and some of the science data from NASA will be "feed stock" for the NOAA service provision.

Dr. Kennel suggested an additional recommendation in light of the clarification of the relationship between NASA and NOAA. There is now an opportunity to take the working relationship between the two agencies to a new level. Dr. Kennel proposed asking Mr. Bolden to have a discussion with NOAA's Administrator on how to make the relationships even closer at the working level. Dr. Ford expressed his endorsement for Dr. Kennel's recommendation and referred it to the Science Committee for its consideration.

Dr. Ford accepted the Committee's Finding as agreed upon by the Council.

Dr. Huntress reviewed the Committee's first Recommendation:

> **Restart of Domestic Pu-238 Production**
> **The Science Committee urges NASA to work with the Department of Energy (DoE) to seek an equitable solution for the restart of domestic production of Plutonium-238 (Pu-238), and for the development and testing of advanced Radioisotope Power Systems (RPSs). The Science Committee requests to be kept informed of developments on this issue at the next meeting.**

He stated that NASA cannot go to the outer solar system without Pu-238. This issue has arisen repeatedly, and it has been on the last two NASA Administrators' lists. The problem has been partially funding and partially the Department of Energy (DoE) relationship. Dr. Edward Weiler, NASA Associate Administrator, Science Mission Directorate, stated that OMB has put funds for this into NASA's budget, and that the remaining issue is how much Pu-238 is to be produced – levels of one to two kilograms or five kilograms. DoE has indicated that new facilities would not be needed for the lower level. Other users, however, may need additional quantities. Mr. Cooke now has an action to determine whether more than one to two kilograms will be needed in the future, and an answer is expected within weeks. Dr. Ford stated that this is an issue that everyone will be happy to see resolved. He accepted the Committee's Recommendation as agreed upon by the Council and agreed to take it forward.

Dr. Huntress reviewed the Committee's second Recommendation:

> **Technology Space Flight Test Program**
> **The Science Committee urges that NASA institute a technology space flight test program to close the "mid-technology readiness level (TRL) gap" between Earth-based tests and flight readiness. This program would take balloon and sounding rocket testing of new technologies and flight instruments to the next level, bridging a critical gap to keeping the technology pipeline open and sustaining a robust technology development community.**

In response to a question, Dr. Huntress acknowledged that it would be similar to the past New Millennium Program. This is an important area for the whole Agency and is broader than just the Science area. Dr. Ford described the situation that occurred at NASA Ames Research Center after Deep Space 1 was launched - when it finally flew and it was clear that no further missions were to follow, many of the best people left and NASA lost valuable talent. These types of missions bring fulfillment to the technologists. After some discussion on whether to change "sounding rocket" to "suborbital rocket," it was agreed to delete from the Recommendation the words "balloon and sounding rocket".

Dr. Ford strongly endorsed the Recommendation and noted that the loss of technical ability has been profound in some parts of NASA. He accepted the Committee's Recommendation as agreed upon by the Council and agreed to take it forward.

Dr. Huntress reviewed the Committee's third Recommendation, which he characterized as an administrative recommendation that, pursuant to the rules, they are required to bring up through the Council:

> **Establish Program Analysis Groups (PAGs) in Astrophysics**
> **The Science Committee recommends establishing PAGs for two other themes in Astrophysics (Physics of the Cosmos and Cosmic Origins).**

Dr. Huntress explained that the Science subcommittees break themselves down into smaller groups called Program Analysis Groups to help the NASA Science enterprise determine how they are going to carry out science objectives. In response to a question, Mr. Hanisee indicated that he would provide information on how the PAGs would be labeled. There are six to twelve people per PAG. Dr. Ford accepted the Committee's Recommendation as agreed upon by the Council and agreed to take it forward.

Space Operations Committee Report

Col. Eileen M. Collins, Chair of the Space Operations Committee, gave her Committee's report. She noted that the Committee has met once and has no formal Recommendations, Observations, or Findings.

Col. Collins reviewed the items contained in the Committee's Workplan for 2010: ISS Operations and Science and Technology Development for Utilization; the Space Shuttle and the transition of the Shuttle to

the next human launch system; commercial launch of cargo to ISS and commercial launch of NASA astronauts (to be handled with the Commercial and/or Exploration Committees); Spacecraft Communication And Navigation (SCAN); and human operations onboard future spacecraft.

The Committee will explore how NASA can best use the ISS. In particular, they will review ISS utility for Earth and climate science, biomedical science, and technologies that will enable human exploration beyond LEO and ascertain whether they are executable from an operational perspective. This will be handled in conjunction with the Exploration and/or Science Committees. Col. Collins noted that in September 2010, the last Shuttle mission will be flown. The Committee will look at adding more flights and the planning associated with the end of operations. In terms of transition to the future human launch systems, the Committee will be looking at ground operations, training, and in-flight mission operations. The Committee will look at commercial crew from the human side and also from the safety side, although safety is primarily the NASA Aerospace Safety Advisory Panel (ASAP) responsibility. Future concepts and requirements for Spacecraft Communication and Navigation (SCAN) development will be examined jointly with the Science Committee.

The Work Plan will also include micro-meteorite protection for HSF, radiation protection for HSF, and human operations beyond LEO from an operational perspective (with the Exploration Committee). Col. Collins noted that two items have been dropped from the Committee's 2010 Work Plan: the Space Flight Human System Standards (SFHSS) and the Human Integration Design Handbook (HIDH), which were reviewed satisfactorily in 2009. The Committee has been thoroughly briefed on NASA's current plan for long term availability for expendable medium launch vehicles.

Col. Collins briefly reviewed the 2010 Budget for the Space Operations Mission Directorate (SOMD). She described SOMD's priorities and challenges for FY 2011. The priorities are: to safely fly the Space Shuttle through retirement; meet NASA's commitments to its international partners; complete ISS assembly and its outfitting; plan for ISS full utilization through 2020; establish the 21st Century Space Launch Complex at KSC; and continue to provide launch services and space communications to NASA's customers. There are several challenges, including maintaining a high-quality Space Shuttle workforce, completing Shuttle retirement in a cost-effective manner, and establishing a robust ISS cargo and crew transportation capability. She noted that $6 B has been budgeted for ESMD over the next five years to develop U.S. commercial crew transportation.

Col. Collins described the recent Space Shuttle Endeavor launch on February 8, 2010. Its major objective was to add the Tranquility Node and the Cupola, which provides a 360-degree view and moves the ISS towards its final configuration. She reviewed the remaining flights for the Space Shuttle. The last scheduled flight will be Space Shuttle Discovery in late September 2010, when NASA will bring up a permanent logistics module. Space Shuttle Atlantis will be prepared for launch on need and ready to go if the Discovery crew needs a rescue. There are no more external tanks for Shuttle flights after Discovery's "launch on need" (LON) tank and constructing one would take about two years. The Discovery LON stack is not manifested to fly, but Col. Collins mentioned there were some informal questions within the committee as to whether it was feasible to actually fly this stack. In response to a question, Col. Collins indicated that the Committee would examine whether Atlantis could be flown unmanned. There was a discussion on whether an unmanned Shuttle could be returned to Earth using its automatic landing system. Col. Collins observed that the Space Shuttle is in great shape with safety and flight readiness reviews that are a national treasure and hopefully the process and culture will not be lost when much of the workforce moves on.. She reviewed the major milestones for the Space Shuttle's retirement, and noted that a lot of work and investment was made in the Kennedy Space Center's Launch Pad 39-B as it was transitioned to CxP.

Col. Collins reviewed a chart showing the effect of the Shuttle's retirement on the combined contractor workforce and another chart showing the layoffs that have been completed. She stated that civil servants are not being laid off, and that contractors are required to maintain a certain level of sustaining engineering through the last flight. Large contractor layoffs are expected to occur after the completion of the last flight. Each company has its own plan to help transition employees. She noted that many employees will leave the area and their skills will be lost. This is a major concern, and the Committee will keep a close eye on the

process. Mr. Alexander described a plan for retaining critical skills that was used when the Titan vehicle was phased out and stated that it was an important lesson learned.

Col. Collins described the status of the ISS. It is 90 percent complete by mass and 98 percent complete by volume. Experiments on ISS have been performed to assure the survival of humans traveling far from Earth, expand our understanding of the laws of nature and enrich lives on Earth, create technology to enable the next explorers go beyond where we have been, and educate and inspire the next generation to take the journey. She reviewed the activities planned for 2010 and 2011.

Col. Collins reviewed the COTS and Commercial Resupply Services (RSS) programs. Two companies are competing to provide these services, Space X and Orbital Sciences. It was suggested that the Space Operations Committee review the ISS's logistics requirements, the timelines for international partner delivery and commercial delivery, the likely slips in commercial deliveries, and the impact those slips would have on the program. There may need to be cut backs, and the contingencies will need to be examined from the Space Operations perspective. Col. Collins agreed and explained that because NASA has been doing a good job at getting logistics preloaded, the Committee is only worried about something that is unexpected; however there is a need to look at the timeline in which various logistics become critical. She described the situation after the Space Shuttle Columbia accident, where ISS went 30 months without a Shuttle flight and NASA had to rely on the Russians. Mr. William Gerstenmaier, Associate Administrator for SOMD, stated that if logistics becomes a problem, NASA could reduce the crew size, curtail research, and, if necessary, de-man the ISS. Col. Collins stated that the NAC Space Operations Committee would continue to watch this issue.

Col. Collins reviewed current ISS transportation arrangements. She noted that Congress has authorized NASA to purchase crew transportation and rescue services from Roscosmos through July 2016. They are currently contracted to provide up transport through 2013 and down transport through 2014.

Dr. Kennel stated that Congress has been insistent that ISS become a National Laboratory and has mandated that a FACA advisory committee be established at NASA for that purpose. He suggested that the extension to 2020 allows new players to get involved in a new era of utilization. Dr. Kennel discussed the differences in utilization philosophy and approach between the U.S. and ESA. He suggested that the Science Committee get a briefing from Mr. Mark Uhran, who is in charge of ISS utilization within SOMD. Dr. Ford endorsed Dr. Kennel's suggestion and thanked Col. Collins for her presentation.

Technology and Innovation Committee Report

Dr. Ford presented the Committee report in place of the Chair, Esther Dyson. The initial meeting of the Technology & Innovation Committee took place on February 11, 2010, at NASA Ames Research Center. The Committee received a presentation by NASA's new Chief Technologist, Dr. Bobby Braun, on Space Technology in NASA's FY2011 President's Budget Request. The Committee also received a presentation from Mr. Ed Lu of Google on the differences between NASA and Google. Dr. Bobby Braun and Mr. Mike Ryschkewitsch, NASA's Chief Engineer, joined the Committee in a discussion of the emerging Space Technology Program. Dr. Paul Hertz, Chief Scientist for SMD, and Dr. Tom Edwards, Director of Aeronautics at Ames Research Center (ARC), talked about technology and innovation processes in their respective directorates. This was followed by a discussion on various barriers to innovation and how the Committee might be helpful. One of the key roles that the Committee identified will be to support Dr. Braun in his efforts to foster a culture of innovation in NASA. The President's FY 2011 Budget proposes a specific allocation of almost $5 B to NASA for new projects over the next five years. Mr. Braun will also be working with all the NASA Mission Directorates on their innovation/technology efforts.

There was general agreement that the Committee should focus its efforts on fostering innovation and a culture of risk tolerance, where appropriate, throughout NASA and not just in innovation programs, while at the same time recognizing the crucial and countervailing pressure of sustaining a culture of human safety. The Committee, expressing confidence in NASA's leadership, adjourned with no formal recommendations to bring to the Council at this time.

Council Roundtable Discussion

Dr. Colladay discussed risk tolerance. He emphasized the importance of isolating technology development from risk aversion in an agency like NASA, which must focus on mission success. He explained that we want to take risks in technology development and retire those risks before the operational phase. NASA technology development needs to be elevated in priority and largely separated from the Mission Directorates because the risk message must be different. It can cause problems to extend risk-taking from technology development to the rest of the Agency. Dr. Ford agreed and clarified that the Technology Committee had recommended taking risks only where it is appropriate. The Committee understands that many parts of the Agency have to have as low a risk as possible; however, the Committee does believe that innovation should be Agency-wide. Dr. Colladay stated that he is concerned about a tendency to encourage the Agency overall (outside R&D programs) to tolerate greater risk. He contrasted NASA with the Defense Advanced Research Projects Agency (DARPA), which can take risks because it has no operational missions. Dr. Ford observed that NASA's failures are public and sometimes involve the loss of life - while DARPA's failures are typically not observed.

Col. Collins read to the Council a statement expressing concerns about HSF and crew transport to the ISS in the future:

> **While a plan is in place, our Committee is concerned with the potential loss of U.S. crew transportation to and from the ISS. The plan is exposed to the reliability of the Russian Soyuz and the timely and safe arrival of commercial crew services. We believe NASA has done a great job with what they have been given, but the reality of developing safe human launch capabilities puts the plan at risk.**

Dr. Ford noted that the statement is not an Observation or Recommendation because it has not yet been deliberated and approved by the Committee; however, it will be in the NAC Minutes from this meeting, and he suggested that her Space Operations Committee discuss it at their next meeting. It was suggested modifying the statement to clarify what "plan" and "launch capability development" it refers to. It was noted that the statement had a lot of validity.

Mr. Alexander suggested that the Commercial Committee, the Space Operations Committee, and possibly the Exploration Committee need to coordinate closely on issues, and perhaps receive briefings together for the next NAC meeting. Dr. Ford recommended that Mr. Alexander coordinate with the other two Committees. Mr. O'Brien stated that his committee also might be interested in the joint briefings. Ms. Rausch advised that a master schedule of NAC committee meetings needs to be put together and distributed once meeting dates are firmed up. Dr. Ford agreed that there is much overlap and that many Committees would benefit from joint meetings prior to the Council meeting. He noted that there are two documents that are being worked on for each committee: the Terms of Reference and the Work Plan. The Terms of Reference are in the concurrence loop and are almost finished. Dr. Ford requested that each Committee Chair ensure that his or her Committee's final Work Plan has been sent to him as he is in the process of integrating them.

Dr. Ford stated that the NAC is in the process of formulating a new Ad-Hoc Task Force on Planetary Defense. In response to a request to clarify the term, he stated that :planetary defense" it is not the same as "planetary protection" against biological contamination. This Task Force's Terms of Reference are directed at looking at objects colliding with or striking Earth. It is focused on NEOs, but does not include the orbital space debris problem. This Task Force should start to meet in the April or May 2010 timeframe. Its purpose will be to provide advice to Mr. Bolden, who shares responsibilities with the Department of Defense (DoD) in this area. In response to a question, Dr. Ford stated that the Ad-Hoc Task Force would meet as often as necessary and would be decoupled from the NAC meeting schedule. In response to a question, Dr. Ford clarified that a Council member can serve on more than one Committee.

Dr. Ford announced that the next quarterly NAC meeting will be held April 27-29, 2010, at JSC. It will be at the Hilton Clear Lake (if available), which would provide good public access. There will be a tour plus a day and a half for meetings. Ms. Rausch and Dr. Ford will work together to release a draft schedule

The July meeting will most likely take place July 20-22, 2010, and is tentatively planned to be held at the Jet Propulsion Laboratory (JPL). The October 5-7, 2010, meeting is tentatively planned to be at the NASA Dryden Flight Research Center (DFRC). Dr. Ford stated that he would like to protect the dates, but leave the locations flexible in case there is a Shuttle launch at KSC overlapping with a NAC meeting date.

Dr. Ford noted that as a result of the current meeting, the NAC will bring to the Administrator one Finding and three Recommendations. The Council members concurred. Dr. Ford thanked the public and NASA personnel for their interest in attending the meeting and invited them to make any comments that they would like to share at this time. None were made. Dr. Ford expressed his appreciation to the staff at NASA Headquarters, in particular Ms. Rausch and the 9 Committee Executive Secretaries, for all their support in making the meeting happen. He also gave particular thanks to members of the Council. He noted that presentations from the meeting will be available on the NASA website in the near future.

The meeting was adjourned.

NASA ADVISORY COUNCIL

NASA Headquarters
300 E Street, SW
Washington, DC 20546

PUBLIC MEETING

February 18-19, 2010
Glennan Conference and VITS Center, Room 1Q39

Agenda

Thursday, February 18, 2010

9:00 – 9:02 am	Call to Order, Announcements	Ms. Diane Rausch, Executive Director NASA Advisory Council, NASA HQ
9:02 – 9:05 am	Remarks by Council Chair	Dr. Kenneth Ford, Chair NASA Advisory Council
9:05 – 9:30 am	Welcome by NASA Administrator	Mr. Charles F. Bolden, Jr. NASA Administrator
9:30 – 10:30 am	NASA FY 2011 President's Budget Request	Dr. Beth Robinson NASA Chief Financial Officer
10:30 – 10:45 am	Break	
10:45 - 11:30 am	NASA Exploration Update	Mr. Douglas Cooke NASA Associate Administrator Exploration Systems Mission Directorate
11:30 – 12:00 noon	Council Discussion	
12:00 Noon – 1:00 pm	Lunch (Council only)	
1:00 – 1:45 pm	Aeronautics Committee Report	Ms. Marion Blakey, Chair
1:45 – 2:30 pm	Audit, Finance & Analysis Committee Report	Mr. Robert Hanisee, Chair
2:30 – 3:15 pm	Commercial Space Committee Report	Mr. Brett Alexander, Chair
3:15 – 3:30 pm	Break	
3:30 – 4:15 pm	Education & Public Outreach Committee Report	Mr. Miles O'Brien, Chair
4:15 – 5:00 pm	Non-Traditional International Partnerships	Mr. Michael O'Brien NASA Assistant Administrator Office of External Relations
5:00 pm	Adjourn	

Friday, February 19, 2010

9:00 – 9:02 am	Call to Order, Announcements	Ms. Diane Rausch, Executive Director NASA Advisory Council, NASA HQ
9:02 – 9:05 am	Remarks	Dr. Kenneth Ford, Chair NASA Advisory Council
9:05 – 9:15 am	Exploration Committee Report	Mr. Richard Kohrs, Chair
9:15 – 9:35 am	IT Infrastructure Committee Report	Gen. Albert Edmonds (Ret.), Chair
9:35 am – 10:20 am	Science Committee Report	Dr. Wesley Huntress, Chair
10:20 am – 10:45 am	Break	
10:45 am – 11:30 am	Space Operations Committee Report	Col. Eileen Collins (Ret.), Chair
11:30 am – 11:50 am	Technology & Innovation Committee Report	Ms. Esther Dyson, Chair
11:50 am – 12:40 pm	Council Roundtable Discussion & Wrap-up	All
12:40 – 1:00 pm	Public Input	
1:00 pm	Adjourn	

NASA ADVISORY COUNCIL
February 18, 2010

Dr. Kenneth M. Ford, Council Chair *Founder and Director, Florida Institute for Human and Machine Cognition (IHMC)*	Mr. Richard Kohrs, Chair, Exploration Committee *NASA (Ret.)*
Ms. P. Diane Rausch, Executive Director *Designated Federal Official* *NASA Headquarters*	Dr. Wesley T. Huntress, Jr., Chair, Science Committee *Director, Geophysical Laboratory, Carnegie Institute of Washington*
Ms. Marion Blakey, Chair, Aeronautics Committee *Chief Executive Officer, Aerospace Industries Association*	Colonel Eileen M. Collins, USAF (Ret.), NASA Shuttle Pilot and Commander (Ret.) Chair, Space Operations Committee *Aerospace Consultant, President of Space Presentations, LLC*
Mr. Robert M. Hanisee, Chair, Audit, Finance and Analysis Committee *Managing Director, Trust Company of the West*	Ms. Esther Dyson, Chair, Technology and Innovation Committee *EDventure Holdings*
Mr. Brett Alexander, Chair, Commercial Space Committee *Executive Director, Commercial Spaceflight Federation*	Dr. Raymond S. Colladay, Ex-Officio *Chair, Aeronautics and Space Engineering Board, National Academies*
Mr. Miles O'Brien, Chair, Education and Public Outreach Committee *Miles O'Brien Productions*	Dr. Charles F. Kennel, Ex-Officio *Chair, Space Studies Board, National Academies*

MEETING ATTENDEES

NASA Advisory Council:

Ford, Kenneth, Chair	Director, IHMC
Rausch, P. Diane, Executive Director	NASA Headquarters
Alexander, Brett	Commercial Spaceflight Federation
Blakey, Marion	Aerospace Industries Association
Collins, Eileen	Space Presentations, LLC
Edmonds, Albert	Edmonds Enterprises Services, Inc.
Hanisee, Robert M.	Trust Company of the West
Huntress, Wesley T, Jr.	Carnegie Institute of Washington
O'Brien, Miles	Miles O'Brien Productions
Colladay, Raymond, Ex-officio	ASEB, National Academies
Kennel, Charles F., Ex-officio	SSB, National Academies

NASA Attendees:

Broadwell, Marguerite	NASA HQ
Davis, Jerry	NASA HQ
Dodson, Estelle	NASA HQ
Emond, John	NASA HQ
Feeley, T Jens	NASA HQ
Green, Thomas	NASA HQ
Heninger, Lyn	NASA/KSC
Hoyt, Diana	NASA HQ
Humphrey, Teresa	NASA HQ
Keeton, Jacob	NASA HQ
Leshin, Laurie	NASA HQ
Minor, Susan	NASA HQ
Munford, Toni	NASA HQ
Nado, Kathy	NASA HQ
Norris, Marian	NASA HQ
Roberts, Rosalee	NASA HQ
Walton, Amy	NASA HQ
Westhelle, Carlos	NASA HQ
Zizier, Sereda	NASA HQ

Other Attendees:

Barber, Andrew	AIA
Bednarek, Stephanie	SpaceX
Benoide, Elissa	House Science & Technology
Bordi, Francesco	Aerospace
Davis, Robert	Northrop-Grumman
Engola, Mary	Ball Aerospace
Grady, Jim	SGEEI

Hand, Eric	*Nature*
Helton, Doug	AMA, Inc.
Kronmuller, Ted	law office
Lane, Carol	Ball
Laur, Susan	UTC
McCohon, Linda	BAH
McDevitt, Joyce	ASAP
Mobilia, Sean	GEI
Reed, Cheryl	JHU/APL
Siazer, Frank	Northrop-Grumman
Smith, Marcia	*Space Policy Online.com*
Unger, Mary	HHSPR International Institute
Werner, Debra	*Space News*
Wofirert, Kyle	SPI-GWU

LIST OF PRESENTATION MATERIAL

1) NASA Fiscal Year 2011 Budget Estimates [Robinson]
2) NASA Exploration Systems Mission Directorate [Cooke]
3) Aeronautics Committee Report [Blakey]
4) Audit, Finance, and Analysis Committee Report [Hanisee]
5) Commercial Space Committee Report [Alexander]
6) Education and Public Outreach Committee Report [O'Brien, Miles]
7) Update on NASA's Cooperation with Non-Traditional Partners [O'Brien, Michael]
8) Information Technology Infrastructure Committee Report [Edmonds]
9) Science Committee Report [Huntress]
10) Space Operations Committee Report [Collins]